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Farbstrahlaufzeichnungskopf, Kassette für einen Tintenstrahlaufzeichnungskopf, Aufzeichnungsgerät damit versehen und Herstellungsverfahren des Kopfes

Tête d'enregistrement à jet d'encre, cartouche pour tête d'enregistrement à jet d'encre, appareil d'enregistrement l'utilisant et méthode pour la fabrication de la tête

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- **PATENT ABSTRACTS OF JAPAN vol. 10, no. 114 (M-473) 26 April 1986 & JP-A-60 242 073 (TOSHIBA)**

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Description

The present invention relates to an ink jet recording head, an ink jet recording head cartridg comprising said ink jet recording head, and to a recording apparatus using the same.

Recently, various recording systems have been developed. Among them, an ink jet recording system in which ink is ejected through ejection outlet in accordance with record signal, is widely used because of the advantage of the small size and the low noise.

The recording head used in such an ink jet recording apparatus is in the form of a detachably mountable recording head cartridge from the standpoint of easy maintenance and service life or the like.

The recording head cartridge detachably mountable to the recording apparatus and the recording apparatus are electrically connected by electric connection contacts (connectors) for transmitting signals for driving the recording head from the recording apparatus. When the recording head is mounted on the recording apparatus, the contacts are electrically connected.

However, in the case of detachably mountable recording head cartridge, there is a liability that the ink leaked through the ejection outlet contaminates the contacts with the result of insufficient electric connection.

In order to solve the problem, U.S. Patent No. 4,635,080 discloses that the contacts are disposed on a surface which is different from an ejection side surface having the ejection outlets of a recording head cartridge having an integral ink container.

The recent demand for the small size of the recording apparatus requires a reduction in the size of the recording head cartridge. In this case, the ink capacity of an ink container constituting the recording head cartridge also decreases. In addition, the difference of the service life from that Of the recording head constituting the head cartridge. Therefore, from the standpoint of cost and from the standpoint of re-use of the recording head, the recording head cartridge in which the ink container and the recording head are separable is considered.

The ink is supplied from the ink container to the recording head through an ink supply port. In addition, the driving signal is supplied by the electric connection between the electric contacts of the recording head and the recording apparatus.

Figures 17 and 18 show an example of a generic ink jet recording head disclosed in the document EP-0 547 596 A3 representing an earlier application. This ink jet recording head is of a type in which electrothermal transducers are used as energy generating means, and ink droplets are ejected by bubble creation in the ink by the thermal energy produced by the electrothermal transducers. These figures show a recording head which is connectable to and separable fr m an ink container. A supporting plate 1 has a top surface to which an energy bas plate and a wiring base plate 9 are bonded. The energy bas plate (heater board) is made chiefly of Si or the like having on a surface thereof heat gen rating portions (heaters) of electrothermal transducers effective to generate thermal energy. The base plate 9 (wiring board) is made chiefly of glass or epoxy resin material and effective to transmit the electric signals from the main assembly of the recording apparatus to the heater board 2. The heater board 2 and the wiring board 9 are electrically connected together by wire bonding 7.

The top surface of the wiring board 9 is provided with contact pads (electric contacts) 4 electrically connected with a flexible wiring board of the main assembly of the recording apparatus.

The ink is supplied from an ink container or recording apparatus side through an ink supply member 6 to a common liquid chamber and ejection nozzles constituted by the bonding between the heater board 2 and a top plate 5, and the ink is ejected through the ejection outlets 8.

However, in such a recording head, an ink joint between an ink supply member 6 and an ink container or an ink supplying portion of the apparatus and a portion having the contact pads 4 of the wiring board 9 are disposed on the same side of the supporting plate 1. Therefore, when the recording head is connected or disengaged, the ink leaked from the ink joint may contacts the contact pads with the result of insufficient or improper electric connection.

Recently, a further reduction in the size is desired. Since the number of pads and the area of each of the pads are more or less limited, it is difficult to further reduce the area occupied by the contact pads. In addition, the area of the recording head supporting plate is determined by the areas of the heater board portion, the wire bonding portion and the contact pad portion. For these reasons, the reduction in the size is not easy.

In order to solve such problems left to be solved, the inventors have previously proposed a recording head in which the disposition of an element substrate and a wiring substrate provided with energy generating means for generating energy available to discharge ink onto a support member is improved and a contact pad is formed on the side opposite to a surface on which the element substrate is disposed.

As a result of the inventor's further studies, it has been found that by improving the bending of the wiring substrate and the wiring thereof, the element substrate and the apparatus side can be electrically connected together by a more reliable and more positive method.

According to document US-A-4,635,080, there is disclosed a generic ink jet recording head according to the preamble of claim 1.

According to the further. document US-A-4,586,056, there is disclosed a thermal ceramic head chip, comprising an element substrate having energy generating means activated in conformity with the recording signal and a first portion of flexible wiring substrat for transmitting the recording signal to the element substrate for transmitting the recording signal to said element substrate disposed on one surface of a support member. A second portion of the flexible wiring substrate is provided with a connecting terminal for effecting the electrical connection of the flexible wiring substrate to the apparatus side. This second portion is disposed on the other surface of the support member by previously bending the flexible wiring substrate and providing an opening at the bent portion, whereupon the bend flexible wiring substrate is put on the support member so that a portion of the support member protrudes through the opening.

The object of the invention is to provide an ink jet recording head and an ink jet recording head cartridge which are more compact and can accomplish highly reliable and stable recording, and a recording apparatus using the same.

It is an aim of the present invention to provide an ink jet recording head and an ink jet head cartridge which are compact and highly reliable as well as easy to manufacture and a recording apparatus using these.

The object of the invention is achieved by means of the features defined in claims 1, 8 and 9. Preferable embodiments of the invention are specified in the subclaims. According to the invention the bent portion of said flexible wiring substrate is of a slit shape which alleviates the bending reaction force of said flexible wiring substrate itself.

Further, the flexible wiring substrate is used as wiring means for transmitting a signal from the recording apparatus side to a heater board, and a contact pad portion for effecting electrical connection with the recording apparatus and a portion having the heater board mounted thereon are disposed on the different surfaces of a support plate, whereby the area of the support plate can be made small and further, the recording head and thus the recording apparatus can be made compact.

Also, the ink joint portion and the contact pad portion are separated into discrete areas and therefore, the contamination of the contact pad portion by the ink can be prevented and defective operation can be prevented.

Particularly, according to the present invention, the flexible wiring substrate is bent and fixedly held on the back of the support member and therefore, there is provided a slit for alleviating the bending reaction force of the flexible wiring substrate itself, whereby the contact pad portion can be stably located at a holding position on that surface of the support plate which is opposite to the surface on which the heater board is disposed.

In the following the invention is further illustrated by embodiments with reference to the enclosed figures.

Figures 1A and 1B are pictorial views showing an ink jet recording head.

Figures 2A and 2B are a sch matic cross-sectional view and a perspective view, respectively, showing an embodiment of the ink jet recording head according to the present invention.

Figure 3 is a top plan view showing another embodiment of the ink jet recording head according to the present invention; the figure shows a portion of a flexible wiring substrate on which a contact pad is disposed as it is not turned back onto the back of a support plate.

Figures 4A and 4B are a top plan view and a cross-sectional view, respectively, showing an embodiment of the ink jet recording head according to the present invention.

Figure 5 is a cross-sectional view showing the construction of another embodiment of the ink jet recording head according to the present invention.

Figure 6 is a cross-sectional view showing the construction of an ink jet recording head before a flexible wiring substrate is joined thereto.

Figure 7 is a cross-sectional view of the ink jet recording head after the flexible wiring substrate is joined thereto in the construction of Figure 6.

Figure 8 shows an ink jet recording head.

Figure 9 is a schematic cross-sectional view of three-layer both-side adhesive film used in an ink jet recording head.

Figure 10 is a cross-sectional view showing the construction of an ink jet recording head.

Figures 11A and 11B are a schematic cross-sectional view and a schematic perspective view, respectively, showing an ink jet recording head cartridge according to an embodiment of the present invention.

Figures 12A to 12C show the external appearances of an ink jet recording head according to the present invention.

Figures 13A to 13D show the external appearances of an ink tank used in combination with the head of the present invention.

Figure 14 is a schematic perspective view showing the essential portions of an embodiment of the ink jet recording apparatus of the present invention.

Figure 15 is a perspective view schematically showing the external appearance of an information processing apparatus carrying the recording apparatus of the present invention thereon.

Figure 16 is a block diagram showing the main electric circuit construction of the information processing apparatus carrying the recording apparatus of the present invention thereon.

Figure 17 is a cross-sectional view showing a conventional ink jet recording head.

Figure 18 is a perspective view showing a conventional ink jet recording head.

Figures 1A and 1B are a top perspective view and a bottom perspective view, respectively, of an conventional ink jet recording head.

The general construction of the ink jet recording head of the present embodiment will first be described with reference to these figures.

A heater board 2 (an element substrate; see Figure

2B) formed of a base material such as an Si substrate having an electro-thermal converting member (an energy generating element) generating energy available to discharge ink formed as film on the surface thereof is disposed on a portion of one surface of a support plate 1 formed of a metal such as aluminum.

A flexible wiring (FPC) substrate 3 formed chiefly of polyimide for transmitting an electrical signal sent from a recording apparatus body to the heater board 2 is disposed in such a manner that a surface thereof on which a connecting terminal connected to the heater board 2 is disposed lies on the same surface as that surface of the support member 1 on which the heater board 2 is disposed and a surface thereof on which is disposed a contact pad (connecting terminal) 4 which is a connecting portion with the recording apparatus side lies on that surface of the support member 1 which is opposite to the surface on which the heater board 2 is disposed. The heater board 2 and the FPC substrate 3 are connected together by wire bonding 7. A grooved top plate 5 for forming a flow path for directing the ink to the vicinity of the electro-thermal converting member is disposed on the heater board 2.

The ink is supplied from an ink supply portion or an ink tank disposed in the recording apparatus body through an ink supply member 6 to a common liquid chamber and a flow path formed by the heater board and the top plate 5 being joined together.

A signal from recording signal supply means on the recording apparatus side is supplied from the apparatus side through a contact pad 4 on the recording head side which contacts with the contact pad 4 (connecting terminal) of the flexible wiring substrate on the recording apparatus side when the recording head is carried on the apparatus. Along therewith, the electro-thermal converting member is driven, whereby the ink is heated and discharged discharge ports 8.

As described above, the flexible wiring substrate is turned back onto the surface opposite to that surface of the support plate on which the heater board is disposed, and the contact pad 4 of the flexible wiring substrate is disposed on the aforementioned opposite surfaced whereby the support plate itself can be made small and thus, the recording head itself can be made compact.

Now, a reaction force against the turning-back of the flexible wiring substrate (a force which tends to release the turning-back) becomes greater as the support plate is made smaller, and the flexible wiring substrate may come off the support plate, whereby electrical connection may become bad. In contrast, in the present invention, two members as will be described below or a construction comprising a combination of these two members is added to thereby solve the above-noted problem.

Figures 2A and 2B are a schematic cross-sectional view and a perspective view, respectively, of the ink jet recording head according to an embodiment of the present invention. In these figures, the same members are given the same reference numerals.

In the present embodiment, slit portions (opening portions) 3a having a closed circumference are provided in th bent portion of the flexible wiring substrate to reduce the aforementioned reaction force of the flexible wiring substrate.

Figure 3 shows that portion of the flexible wiring substrate according to another embodiment of the present invention on which the contact pad is disposed as it is not turned back onto the back of the support plate. The slit portions 3a are provided at two locations just corresponding to the turned-back portion of the flexible wiring substrate. Each corner of these slit portions is R-shaped (curved), whereby the provision of the slit portions may not damage the flexible wiring substrate. In the present embodiment, this R shape is R0.3 mm. The reference numeral 11 designates openings formed in the flexible wiring substrate, and with the openings in the support plate, these openings 11 provide a reference for positioning when the head is carried on the apparatus side. In the present embodiment, the dimension between the centers of these openings 11 and 15 mm.

Figure 4A is a top plan view of a part of the slit portion. Figure 4B is a cross-sectional view of the slit portion according to the embodiment shown in Fig. 2A, 2B. As shown, the slit portion is formed as an aperture extending through the flexible wiring substrate comprising base film 31 of polyimide, copper foil 33 for wiring and cover film 34 of polyimide layered successively. The reference numeral 32 denotes an adhesive layer.

As described above, in the present embodiment, the slit portions (opening portions) are provided in the bent portion of the FPC substrate 3, whereby the contact pad can be easily and reliably disposed on the surface different from the heater board 2 and therefore, the both surfaces of the support plate 1 can be effectively utilized and the area of the support plate 1 can be reduced and thus, the recording head can be made compact and also, the recording head and the recording apparatus will suffer little from malfunctioning.

Also, the contact pad portion is disposed on the side opposite to the ink joint portion and therefore, the contamination of the pad portion by the ink can be prevented.

The manufacturing process for the recording head according to the present embodiment will now be described with respect to the essential portions thereof.

An adhesive agent such as a silicone adhesive agent like epoxy adhesive agent, SE9145 or SE4410 (trade designations of these agents produced by Tore Dow Corning Silicone, Inc.) is first applied to the necessary portion of one surface of a cleaned support member as by screen printing. The support member may be ceramics or glass, but may desirably be a metal such as Al.

Subsequently, the heater board 2 is positioned n and adhesively secured to one end portion of the surface to which the adhesive agent has been applied, and th wire bonding pad side is positioned on and adhesively secured to the other end portion of the same surface in such a manner as to protrude over half of th contact pad side of the FPC wiring substrate 3 (Figure 3).

Thereafter, the heater board 2 and the connecting terminal of the wiring substrate 3 are connected together as by wire bonding 7.

A top plate is adhesively secured to the heater board to thereby form an ink path and a common liquid chamber, and the ink supply member 6 is connected to the top plate and is sealed by a sealant such as liquid silicone rubber.

Subsequently, both-side adhesive film 10 is positioned on and cemented in advance to the back of the support member, and the contact pad side of that portion of the FPC substrate 3 which protrudes from the support member is bent by 180° by a bending portion having a slit and is positioned on and superposedly urged against the adhesive film, and is adhesively secured to this film.

In the aforedescribed embodiment, the slit portions are provided at two locations in the bent portion of the flexible wiring substrate 3, but when this is viewed in terms of a layer construction, slits are formed in both of the base materials on the base film side and the cover film side of polyimide positioned above and below the flexible wiring substrate, whereas in another embodiment, as shown in Figures 3 and 5, a slit portion is not provided on the base film side, but is provided only on the cover film side.

As a result, as in the aforedescribed embodiment, the FPC substrate is bent onto the back of the support member and adhesively secured thereto and therefore, there is provided a slit shape which alleviates the bending reaction force of the FPC substrate itself, whereby the contact pad portion can be stably positioned and disposed on that surface of the support plate which is opposite to the surface on which the heater board is disposed, and split or the like may not occur from the slit.

In each of the aforedescribed embodiments, the slit portions are provided in the bent portion of the flexible print substrate, whereby the reaction force of the flexible print substrate against bending is reduced and thereby, that portion of the flexible print substrate on which the contact pad position is disposed is reliably disposed on the back of the support plate (the surface opposite to the surface on which the heater board is disposed). Described will hereinafter be made of such ink jet recording head providing a construction of adhesive securement, which may be considered to be similar to the previous embodiments except for the provision of slit portions according to the invention.

Figure 6 is a schematic cross-sectional view illustrating the general construction of the ink jet recording head. A heater board 2 made chiefly of an Si substrate having a heater for causing heat energy to act on the ink formed as film and the lower portion of the wire bonding of a flexible wiring substrate 3 made chiefly of polyimide for transmitting an electrical signal sent from the recording apparatus body to the heat r board 2 and having a reinforcing plate 30 of glass epoxy or the like joined to the back thereof are adhesively secured to the upper surface of a support member 1 comprising an aluminum plate or the like.

A positioning aperture 9 is formed in the support member 1, and a contact pad portion 4 for contact with the recording apparatus body, a reinforcing plate 302 and a positioning aperture 11 which has already been described in the previous embodiments are formed in that portion of the flexible wiring substrate 3 which protrudes from the support member.

Subsequently, that portion of the flexible wiring substrate 3 which protrudes from the ink supply member 6 is bent by 180° and is adhesively secured to the back of the support member 1 so that the contact pad portion 4 may be disposed on the back of the support member 1, as shown in Figure 7.

The heater board 2 and the flexible wiring substrate 3 are connected together by wiring bonding 7, and the contact pad portion 13 of the flexible wiring substrate 12 of the recording apparatus body is contacted by the contact pad portion 4 of the flexible wiring substrate 3, whereby an electrical signal is supplied.

The ink is supplied from an ink supply portion or an ink tank disposed in the recording apparatus body through the ink supply member 6 to a common liquid chamber and discharge ports 8 formed by the heater board 2 and the top plate 5 being joined together.

Both-side adhesive film 401 is cemented to the back of the support member 1. Subsequently, that portion of the flexible wiring substrate 3 which protrudes from the support member 1 is bent by 180° and is adhesively secured to the back of the support member 1 while the positioning aperture 9 in the support member 1 and the positioning aperture 11 in the flexible wiring substrate 3 are positioned by the round pin of a securement positioning jig, not shown. Figure 8 shows a schematic view in which the head is seen through the back thereof so that the disposition of the adhesive film can be seen. As described above, the heater board 2 and the flexible wiring substrate 3 are connected together by wire bonding 7, and the contact pad portion 13 of the flexible wiring substrate 12 of the recording apparatus body is contacted by the contact pad portion 4 of the flexible wiring substrate 3, whereby an electrical signal is supplied.

A flexible wiring substrate 13 is positioned and fixed on the carriage 12 of the recording apparatus body by a positioning pin 14.

Further, the positioning of the recording head is effected by the positioning pin 14 and the positioning apertures 9 and 11 of the recording head.

From such construction of the head, the flexible wiring substrate is positioned and fixed on the back of the support member.

For the fixing, use is mad of acrylic adhesive securing means such as both-side adhesive means No. 5911 or No. 5916 (trade d signations of the adhesive means produced by Nitto Denko Co., Ltd.).

As performances required of such adhesive securing means, mention may be made of the stable securement holding property during securement against a repulsion caused by the flexible wiring substrate being bent onto the back side of the support member, and the chemical resistant property to ink components.

Thus, by the adoption of the both-side adhesive film, the flexible wiring substrate can be bent onto the back of the support member and be reliably secured thereto with the support member reduced in size, and the downsizing of the recording head can be achieved.

A film of single-layer structure is used as the both-side adhesive film, and with the countermeasure for mass production in its actually mounted form taken into account, such film is made into the form of a tape in accordance with the area of the flexible wiring substrate on the fixed back side.

The working of adhesive film tape is such that an adhesive layer is stuck on released paper, the area of the stuck portion of the adhesive film layer is punched by a press, the other portion than the adhesive surface is removed and the tape is wound in the form of a roll with the adhesive film layer sandwiched by the released paper.

A problem in making such tape is that when the adhesive film is punched, both adhesive layers glue together in the cross-sections of the portion used as the adhesive tape and the portion to be removed and the adhesive layer of the portion to be removed pulls the adhesive layer around the glued portion used as the adhesive tape and therefore, it becomes impossible to hold an effective adhesive area.

As a remedy for such adhesive film structure, use can be made of a modified three-layer structure type in which a discrete base material such as alkaliproof polyimide material which is not corroded by ink components (for example, trademark "YUPIREX" produced by Ube Kosan Co., Ltd.) is provided as an intermediate layer in the adhesive layer and the adhesive film material used in the first embodiment is disposed on and under it. Figure 9 shows a schematic cross-sectional view of film of such three-layer structure. In Figure 9, the reference characters 30a and 30b designate released paper, the reference characters 29a and 29b denote adhesive layers, and the reference numeral 28 designates an intermediate layer.

By using adhesive film of such structure, the press punching property in the manufacturing process is improved and reliability is enhanced in the actual mounting during production, and this also leads to a reduction in cost.

Description will now be made f an ink jet recording head in which in order to make the recording head more compact, the location at which the flexible wiring substrate is adhesively secured to th back of th support member is brought close to the discharge ports of the recording head.

Where as shown in Figure 10, the location at which the flexible wiring substrate is stuck on the back of the support member is brought close to the discharge ports of the recording head, it would occur to mind that ink slightly leaking out of the ink discharge ports 8 adheres to the end surface of the flexible wiring substrate 3. If the ink used in the ink jet recording head adheres to the end surface of the flexible wiring substrate, the flexible wiring substrate 3 may be corroded by a solvent such as alcohol contained in the ink or the adhesive force between the flexible wiring substrate 3 and the reinforcing plate 301 may be reduced, whereby the flexible wiring substrate 3 may peel.

In the present embodiment, in order to eliminate such an undesirable possibility and make the recording head more compact, polyimide film synthesized by the polycondensation of biphenyl tetracarboxylic acid dianhydride and diamine is used as the base material of the flexible wiring substrate, and discretely therefrom or together therewith, a phenol nitrile rubber adhesive agent is used to join the polyimide film and a reinforcing plate together.

As polyimide film synthesized by the polycondensation of biphenyl tetracarboxylic acid dianhydride and dyamine, use can be made, for example, of a commercially available material such as "YUPIREX" (trade mark of this material produced by Ube Kosan Co., Ltd.). This film, as compared with the conventional polyimide film, has features such as high hardness, low water absorbing property and high heat resistance and therefore, the reliability of wire bonding is enhanced.

Also, the phenol nitrile rubber adhesive agent, as compared with ordinary acryl adhesive agents, is excellent in chemical resistance and high in heat resistance and therefore can further enhance the ink resisting property and reliability of the ink jet recording head.

Thus, by adopting the above-described construction, further compactness of the recording head can be achieved.

While in the foregoing, description has been undividually made of the invention in which slits are provided to reduce the bending reaction force of the flexible wiring substrate which increases as the support plate for the recording head is shortened and the head is made more compact, or the reliably adhesively secure the flexible wiring substrate by an easy process, and an ink jet recording head which uses the both-side adhesive film, the both-side adhesive film is used at the location whereat the adhesive agent is disposed as indicated by the reference numeral 10 in Figure 2, whereby the effects of the two can be synergistically obtained and thus, a more desirable form is provided.

Figure 11A shows at schematic cross-sectional view of an ink jet head cartridge in which the ink jet recording head described in the previous embodiment is connected to a removably mountable ink tank 11, and Figure 11B shows a schematic perspective view of the ink jet head cartridge, and as shown in the previous embodiment, the recording head unit can be made compact and in accordance therewith, the ink tank can also be made compact.

Figures 12A to 12C show the external appearances of the ink jet head cartridge shown in Figure 11 with the head unit removed therefrom. Figure 12A is a view of the head as it is seen from the ink tank side, and a filter 17 is provided in a supply portion (a tubular member having a radius of 1.75 mm) for receiving the supply of the ink from the ink tank. Figure 12B is a view of the head as it is seen from the side of the discharge ports 8, and Figure 12C is a side view thereof.

Figures 13A to 13D show the external appearances and cross-sectional views of the ink jet head cartridge with the ink tank portion removed therefrom. Figure 13A is a view of the ink tank as it is seen from above it, and two coupling pawls 18 for effecting the coupling of the ink tank to the recording head are provided. Figure 13B is a view of the head as it is seen from the direction of a supply portion 19 coupled to the head and the ink supply portion, Figure 13C is a view of the head as it is seen from the opposite side of Figure 13B, and the reference numeral 20 designates an atmosphere communication port for communicating the ink tank with the atmosphere, and the reference numeral 21 denotes a gap for receiving a guide portion when carried on a carriage. Figure 13D is a cross-sectional view of the ink tank, and an ink absorbing member 22 for retaining the ink is disposed in the ink tank.

Reference is now had to Figure 14 to describe an example of an ink jet recording apparatus having mounted thereon an ink jet recording head and an ink jet recording head cartridge manufactured by the utilization of the above-described embodiment. Figure 14 is a schematic perspective view showing the essential portions of an example of the ink jet recording apparatus.

In Figure 14, the reference numeral 320 designates a removable cartridge type ink jet recording head cartridge of integral recording liquid reservoir structure provided with a plurality of ink discharge ports opposed to the recording surface of recording paper (not shown) which is a recording medium conveyed onto a platen 324. The reference numeral 316 denotes a carriage for supporting the ink jet recording head cartridge 320 thereon. The carriage 316 is connected to a portion of a driving belt 318 for transmitting the drive force of a drive motor 317 and is slidable along two guide shafts 329A and 329B disposed parallel to each other. Thereby, the ink jet recording head cartridge 320 is reciprocally movable over the full width of the recording paper.

The reference numeral 326 designates a recovery device for effecting the recovery and prevention of unsatisfactory ink discharge from the recording head. The recovery device 326 is disposed at a predetermined location within the movement range of the ink jet recording head cartridge 320, for exampl , a locati n opposed to the home position. Th recovery device 326 effects the capping of the discharge ports of the ink jet recording head by the drive force of a motor 322 transmitted through a transmission mechanism 323. In association with the capping operation for the discharge ports of the ink jet recording head by the cap 326A of the recovery device 326, the suction of ink from the discharge ports by suitable suction means (not shown) provided in the recovery device 326 is effected, or in a form of apparatus (not shown) wherein ink is supplied from the apparatus side to a recording head, the forced delivery of ink by suitable pressing means (not shown) provided in the ink supply path to the ink jet recording head is effected. Thereby, the ink is forced out of the discharge ports, whereby the recovery process of removing a foreign substance such as viscosity-increased ink in the discharge ports is carried out.

The reference numeral 330 denotes a blade as a wiping member disposed on a side of the recovery device 326 and formed of silicone rubber. This blade 330 is held in a cantilever fashion by a blade holding member 330A, and like the recovery device 326, it is operated by the motor 322 and transmission mechanism 323 and becomes engageable with the discharge port surface of the ink jet recording head. Thereby, at appropriate timing, for example, during the recording operation of the ink jet recording head or after the recovery process by the recovery device 326, the blade 330 can be protruded within the movement range of the ink jet recording head to thereby wipe off a foreign substance such as condensation, wet or dust adhering to the discharge port surface with the movement of the ink jet recording head.

The driving of the recording paper conveying means, carriage and recovery device of this ink jet recording apparatus, and further the driving of the recording head, are controlled, for example, on the basis of a command or a signal output from control means including a CPU on the apparatus body side.

Description will now be made of the construction and electric circuit of an information processing apparatus incorporating therein the recording apparatus according to the present embodiment.

Figure 15 is a schematic perspective view showing the external appearance of an information processing apparatus 604 incorporating therein the recording apparatus according to the present embodiment. In Figure 15, the reference numeral 601 designates the above-described printer unit, the reference numeral 602 denotes a keyboard unit provided with keys for inputting characters and numerals, and keys for giving various commands, and the reference numeral 603 designates an indicating unit provided with an indicator.

Figure 16 is a block diagram showing the electric circuit construction of the information processing apparatus according to the present embodiment.

In Figure 16, the reference numeral 501 denotes a controller performing main control, the reference num ral 502 designates a CPU, for example, in the form of a microcomputer for executing a certain procedure, the reference numeral 503 denotes an RAM provided with an area for evolving text data and image data and a working area, the reference numeral 504 designates an ROM storing therein a program corresponding to said procedure and fixed data such as other font data, the reference numeral 505 denotes a timer for creating the execution cycle of the CPU 502 and creating the necessary timing during the recording operation of the printer unit 601, and the reference numeral 506 designates an interface unit for linking the signal from the CPU 502 to the surrounding devices.

The reference numeral 507 denotes a controller for the printer unit 601, the reference numeral 508 designates a head driver for delivering a recording signal and electric power to the head cartridge 101, the reference characters 509a and 509b denote motor drivers for delivering signals and electric power necessary to drive a carrier motor 402a and a conveying motor 402b, the reference numeral 510 designates a carrier sensor for detecting the position of the carrier 102 and judging whether the carrier 102 is, for example, at the home position, and the reference numeral 511 denotes a paper sensor for detecting the presence or absence of the recording medium 6 in order not to cause recording to be effected on any other plate than the recording medium 6 when the recording medium 6 is not yet inserted or when recording has been terminated up to the terminal end of a page.

Further, the reference numeral 605 designates an external memory device such as FDD, HDD or a RAM card, and the reference numeral 512 denotes an external interface unit for effecting, for example, communications with other information processing apparatus, and controlling the surrounding instruments by being directly connected to an internal bus.

Although not shown in the block diagram of Figure 16, there is a power source unit for supplying electric power to the above-described electric circuit, and this power source unit includes, for example, a battery of the charging type, a disposable dry battery or a converter for AC power source used when the information processing apparatus is fixedly used.

The present invention brings about an excellent effect particularly in a recording head and recording apparatus of the type in which heat energy is utilized to discharge ink, among ink jet recording systems.

With regard to the typical construction and principle of the present invention, it is preferable to use the basic principle disclosed, for example, in U.S. Patents Nos. 4,723,129 and 4,740,796. This system is applicable to both of the so-called on-demand type and continuous type, and particularly in the case of the on-demand type, it is effective becaus at least one driving signal corresponding to recording information and providing a rapid temperature rise exceeding nuclear boiling is applied to an electro-thermal converting member disposed correspondingly to a sheet or a liquid path retaining liquid (ink) therein, thereby generating heat energy in the electro-thermal converting member and causing film boiling on the heat acting surface of a recording head with a result that a bubble can be formed in the liquid (ink) correspondingly to this driving signal at one to one. By the growth and contraction of the bubble, the liquid (ink) is discharged through a discharge opening to thereby form at least one droplet. If this driving signal is made into a pulse shape, the growth and contraction of the bubble take place appropriately on the spot and therefore, the discharge of the liquid (ink) particularly excellent in responsiveness can be accomplished, and this is more preferable. This driving signal of the pulse shape may suitably be the one as described in U.S. Patents Nos. 4,463,359 and 4,345,262. If the conditions described in U.S. Patent No. 4,313,124 of an invention relating to the temperature rise rate of said heat acting surface are adopted, more excellent recording can be accomplished.

As the construction of the recording head, besides a construction comprising a combination of discharge ports, liquid paths and an electro-thermal converting member (straight liquid flow paths or right-angled liquid flow paths) as disclosed in each of the above-mentioned patents, the construction disclosed in U.S. Patents Nos. 4,558,333 and 4,459,600 wherein a heat acting portion is disposed in a crooked area is also covered by the present invention.

Further, the recording head of the full line type having a length corresponding to the width of the largest recording medium recordable by the recording apparatus may be of the construction as disclosed in the above-mentioned patents wherein said length is satisfied by a combination of a plurality of recording heads, or of the construction as a unitarily formed recording head, and the present invention can display the above-described effect more effectively.

In addition, the present invention is also effective when use is made of a recording head of the interchangeable chip type which, by being mounted on an apparatus body, can be electrically connected to the apparatus body and can be supplied with ink from the apparatus body, or a recording head of the cartridge type which is integrally provided in the recording head itself.

Also, the addition of the recovery means, preliminary auxiliary means, etc. to the recording head which are provided as the construction of the recording apparatus of the present invention can further stabilize the effect of the present invention, and this is preferable. More specifically, these are capping means, cleaning means and pressing or suction means for the recording head, an electro-thermal converting member or a heating element discrete therefrom, or preheating means using a combination thereof, and the execution of a preliminary discharge mode in which discharge discret from recording is effected is also effective to accomplish stable recording.

Furthermore, the recording mod of the recording apparatus is not limited to a recording mode for the mainstream color such as black, but the recording head may be constructed as a unit or may be provided by a combination of a plurality of heads, and the present invention is also very effective for an apparatus provided with at least one of a compound color consisting of different colors and a full color consisting of mixed colors.

The above embodiments of the present invention have been described as using liquid ink, but in the present invention, use can also be made of ink which is solid at room temperature, or ink which becomes softened at room temperature. In the above-described ink jet apparatus, it is usual to adjust the temperature of the ink itself within a range of 30°C to 70°C, thereby controlling the viscosity of the ink so as to be within a stable discharge range. Therefore, in such an ink jet apparatus, use can be made of ink which is in liquid phase during the use of the apparatus when a recording signal is imparted. In addition, in order to make heat energy used positively as energy for the phase change of ink from its solid state to its liquid state to thereby prevent the temperature rise of the head otherwise caused by the heat energy, or in order to solidify ink as it is left unused to thereby prevent the evaporation of the ink, ink which is liquefied only by heat energy such as ink which is liquefied and discharged in its liquid state by heat energy being imparted thereto in conformity with a recording signal, or ink which begins to solidify at a point of time whereat it arrives at a recording medium is also usable in the present invention.

In the above-described embodiments, among ink jet recording heads, particularly a recording head of a form which utilizes heat energy to bubble the ink and discharges ink droplets has been shown, but the present invention can also suitably be applied to recording heads of other types, for example, a recording head of a form which uses an electrostrictive element or the like to discharge ink droplets.

Furthermore, the recording apparatus of the present invention is not limited to the form of an apparatus provided integrally or discretely as the output end of an information processing apparatus such as a word processor or a computer as previously described, but may also assume the form of a copying apparatus combined with a scanner, or a facsimile apparatus having the signal transmitting and receiving functions.

Also polyimide film synthesized by the polycondensation of biphenyl tetracarboxylic acid dianhydride and diamine is used as the base material of the flexible wiring substrate and a phenol nitrile rubber adhesive agent is used for the joint of the polyimide film and the reinforcing plate, whereby the ink resisting property of the polyimide film of the flexible wiring substrat and the adhesive layer is enhanced, and even when the ink adheres thereto, the flexible wiring substrate does not peel and thus, the flexible wiring substrate can be disposed to the vicinity of the ink discharge ports, and further compactness of the recording head can be achieved.

Also, the enhanced ink resisting property of the ink jet recording head permits, for example, the use of ink of higher alkali than before and thus, the selection range of ink widens and recording of high quality images becomes possible.

Further, the polyimide film used in the present invention, as compared with conventional polyimide film, has features such as high hardness, low water absorbing property and high heat resistance and therefore, the reliability of wire bonding is also enhanced.

Claims

1. An ink jet recording head for discharging ink from discharge ports (8) to thereby effect recording, comprising an element substrate (2) having energy generating means for causing energy for discharging the ink in conformity with a recording signal to act on the ink and a first portion of a flexible wiring substrate (3) for transmitting said recording signal to said element substrate (2) disposed on one surface of a support member (1), **characterized in that** a second portion of said flexible wiring substrate (3) provided with a connecting terminal (4) for effecting the electrical connection of said flexible wiring substrate to the apparatus side is disposed on the other surface of said support member (1) by said flexible wiring substrate (3) being bent, wherein the bent portion of said flexible wiring substrate has an opening portion (3a) with a closed circumference, said opening position alleviating the bending reaction force of said flexible wiring substrate itself.

2. An ink jet recording head according to claim 1 characterized by a both-side adhesive film (401) stuck on the back of the support member (1) in such a manner that the connecting terminal (4) is disposed on the side opposite to that surface of the support member on which the substrate (2) is disposed, and the support member (1) and the flexible wiring substrate (3) are positioned and fixed with the both-side adhesive film interposed therebetween.

3. An ink jet recording head according to claim 2, **characterized in that** the both-side adhesive film (401) is formed of an acryl jointing material.

4. An ink jet recording head according to claim 3, **characterized in that** the both-side adhesive film is of three-layer struc-

ture (28; 29a, 29b; 30a, 30b) using a discrete member (28) as an intermediate layer.

5. An ink jet recording head according to any of claims 2 to 4, **characterized in that** the flexible wiring substrate (3) uses as its base material polyimide film (31; 34) synthezised by the polycondensation of biphenyl tetracarboxylic acid dianhydride and diamine.

6. An ink jet recording head according to any of claims 2 to 5, **characterized in that** a reinforcing plate (302) is joined to the joint surface between the flexible wiring substrate (3) and the support member (1), and said reinforcing plate and said flexible wiring substrate are joined together by a phenol nitrile rubber adhesive agent.

7. An ink jet recording head according to any of claims 2 to 6, **characterized in that** the energy generating means is an electro-thermal converting member adapted to generate heat by electrical energy being imparted thereto, and cause a state change in the ink to thereby effect the discharge of the ink.

8. An ink jet recording head cartridge having the ink jet recording head according to one of claims 1 to 7, and an ink tank (16) removably mountable to said recording head.

9. An ink jet recording apparatus having the ink jet recording head according to one of claims 1 to 7, and a connecting terminal portion (12-15) for effecting the connection with said connecting terminal (4) disposed on said other surface differing from the surface of the support member (1) of said ink jet recording head on which said element substrate (2) is disposed.

Patentansprüche

1. Tintenstrahlaufzeichnungskopf zum Abgeben von Tinte aus Abgabeöffnungen (8), um dadurch eine Aufzeichnung zu bewirken, mit einem Elementsubstrat (2) mit einer Energieerzeugungseinrichtung zum Verursachen einer Energie zum Abgeben der Tinte in Übereinstimmung mit einem Aufzeichnungssignal, um auf die Tinte zu wirken, und einem ersten Abschnitt eines flexiblen Verdrahtungssubstrats (3) zum Übertragen des Aufzeichnungssignals auf das auf einer Fläche eines Stützelements (1) angeordnete Elementsubstrat (2), **dadurch gekennzeichnet, daß** ein zweiter Abschnitt des flexiblen Verdrahtungssubstrats (3), der mit einem Verbindungsanschluß (4) zum Bewirken der elektrischen Verbindung des flexiblen Verdrahtungssubstrats mit der Geräteseite vorgesehen ist, an der anderen Fläche des Stützelements (1) angeordnet ist, indem das flexible Verdrahtungssubstrat (3) gebogen wird, wobei der gebogene Abschnitt des flexiblen Verdrahtungssubstrats einen Öffnungsabschnitt (3a) mit einem geschlossenen Umfang hat, wobei die Öffnungsposition die Biegereaktionskraft des flexiblen Verdrahtungssubstrats selbst mildert.

2. Tintenstrahlaufzeichnungskopf nach Anspruch 1, **gekennzeichnet durch** eine doppelseitige Klebefolie (401), die auf der Rückseite des Stützelements (1) auf eine derartige Weise klebt, daß der Verbindungsanschluß (4) auf der dieser Fläche des Stützelements gegenüberliegenden Seite angeordnet ist, auf der das Substrat (2) angeordnet ist, und daß das Stützelement (1) und das flexible Verdrahtungssubstrat (3) mit der dazwischen gesetzten doppelseitigen Klebefolie positioniert und fixiert sind.

3. Tintenstrahlaufzeichnungskopf nach Anspruch 2, **dadurch gekennzeichnet, daß** die doppelseitige Klebefolie (401) aus einem Acrylverbindungsmaterial gebildet ist.

4. Tintenstrahlaufzeichnungskopf nach Anspruch 3, **dadurch gekennzeichnet, daß** die doppelseitige Klebefolie einen dreischichtigen Aufbau hat (28; 29a, 29b; 30a, 30b), wobei ein abgegrenztes Element (28) als eine Zwischenschicht verwendet wird.

5. Tintenstrahlaufzeichnungskopf nach einem der Ansprüche 2 bis 4, **dadurch gekennzeichnet, daß** das flexible Verdrahtungssubstrat als sein Grundmaterial eine Polyimidfolie (31; 34) verwendet, die durch die Polykondensation von Biphenyl-Tetra-Karbonsäure Dianhydrid und Diamin synthetisiert ist.

6. Tintenstrahlaufzeichnungskopf nach einem der Ansprüche 2 bis 5, **dadurch gekennzeichnet, daß** eine verstärkende Platte (302) an die Verbindungsfläche zwischen dem flexiblen Verdrahtungssubstrat (3) und dem Stützelement (1) angeschlossen ist, und wobei die verstärkende Platte und das flexible Verdrahtungssubstrat durch ein Phenolnitril-Gummiklebemittel miteinander verbunden sind.

7. Tintenstrahlaufzeichnungskopf nach einem der Ansprüche 2 bis 6, **dadurch gekennzeichnet, daß** die Energieerzeugungseinrichtung ein elektrothermisches Umwandlungselement ist, das zum Erzeugen von Wärme durch elektrische Energie, die darauf aufgebracht wird, geeignet ist, und eine Zustandsänderung in der Tinte veranlaßt, um dadurch die Abgabe der Tinte zu bewirken.

8. Tintenstrahlaufzeichnungskopfkartusche mit dem Tintenstrahlaufzeichnungskopf nach einem der Ansprüche 1 bis 7 und einem Tintenbehälter (16), der an dem Aufzeichnungskopf abnehmbar montierbar ist.

9. Tintenstrahlaufzeichnungsgerät mit dem Tintenstrahlaufzeichnungskopf nach einem der Ansprüche 1 bis 7 und einem Verbindungsanschlußabschnitt (12-15) zum Bewirken der Verbindung mit dem Verbindungsanschluß (4), der an der anderen Fläche angeordnet ist, die sich von der Fläche des Stützelements (1) des Tintenstrahlaufzeichnungskopfes unterscheidet, auf der das Elementsubstrat (2) angeordnet ist.

Revendications

1. Tête d'enregistrement à jets d'encre destinée à décharger de l'encre à partir d'orifices de décharge (8) pour effectuer ainsi un enregistrement, comportant un substrat (2) à éléments ayant des moyens de génération d'énergie destinés à amener de l'énergie, destinée à décharger l'encre en conformité avec un signal d'enregistrement, à agir sur l'encre, et une première partie d'un substrat souple (3) de câblage destinée à transmettre ledit signal d'enregistrement audit substrat (2) à éléments disposé sur une surface d'un élément (1) de support, caractérisée en ce qu'une seconde partie dudit substrat souple (3) de câblage pourvue d'une borne (4) de connexion pour réaliser la connexion électrique dudit substrat souple de câblage sur le côté de l'appareil est disposée sur l'autre surface dudit élément (1) de support par le fait que ledit substrat souple (3) de câblage est courbé, la partie courbée dudit substrat souple de câblage présentant une partie à ouvertures (3a) ayant une circonférence fermée, ladite partie à ouverture atténuant la force de réaction à la courbure dudit substrat souple de câblage lui-même.

2. Tête d'enregistrement par jets d'encre selon la revendication 1,
caractérisée par
un film adhésif à double face (401) collé sur le dos de l'élément de support (1) d'une manière telle que la borne (4) de connexion est disposée sur le côté opposé à la surface de l'élément de support sur laquelle le substrat (2) est disposé, et que l'élément de support (1) et le substrat souple (3) de câblage sont positionnés et fixés avec le film adhésif double-face interposé entre eux.

3. Tête d'enregistrement à jets d'encre selon la revendication 2,
caractérisé en ce que
le film adhésif double face (401) est formé d'une matière acrylique d'assemblage.

4. Tête d'enregistrement à jets d'encre selon la revendicati n 3,
caractérisée en ce que
le film adhésif double face est d'une structure à trois couches (28 ; 29a, 29b ; 30a, 30b) utilisant un élément discret (28) en tant que couche intermédiaire.

5. Tête d'enregistrement à jets d'encre selon l'une quelconque des revendications 2 à 4, caractérisée en ce que
le substrat souple (3) de câblage utilise, en tant que matière de base, un film (31 ; 34) de polyimide synthétisé par la polycondensation d'un dianhydrure d'acide biphényltétracarboxylique et d'une diamine.

6. Tète d'enregistrement à jets d'encre selon l'une quelconque des revendications 2 à 5, caractérisé en ce que
une plaque (302) de renfort est jointe à la surface de jonction entre le substrat souple (3) de câblage et l'élément (1) de support, et ladite plaque de renfort et ledit substrat souple de câblage sont joints l'un à l'autre par un agent adhésif du type caoutchouc nitrile phénolique.

7. Tête d'enregistrement à jets d'encre selon l'une quelconque des revendications 2 à 6, caractérisée en ce que
les moyens de génération d'énergie comprennent un élément de conversion électrothermique conçu pour générer de la chaleur par l'application d'énergie électrique de cet élément, et pour provoquer un changement d'état de l'encre afin d'effectuer la décharge de l'encre.

8. Cartouche à tête d'enregistrement à jets d'encre ayant la tête d'enregistrement à jets d'encre selon l'une des revendications 1 à 7, et un réservoir d'encre (16) pouvant être monté de façon amovible sur ladite tête d'enregistrement.

9. Appareil d'enregistrement à jets d'encre ayant la tête d'enregistrement à jets d'encre selon l'une des revendications 1 à 7, et une partie (12-15) à borne de connexion pour effectuer la connexion avec ladit borne (4) de connexion disposée sur ladite autre surface différente de la surface de l'élément de support (2) de ladite tête d'enregistrement à jets d'encre sur laquelle ledit substrat (2) à éléments est disposé.

FIG. 1A

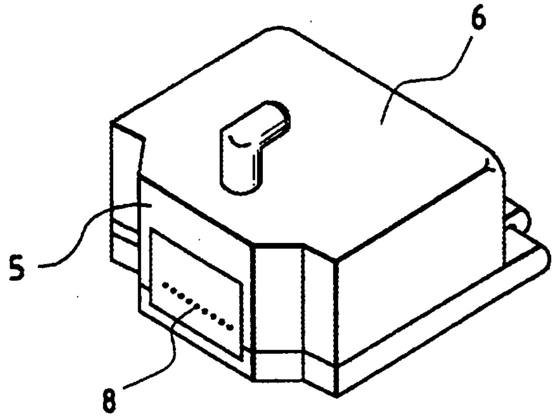

FIG. 1B

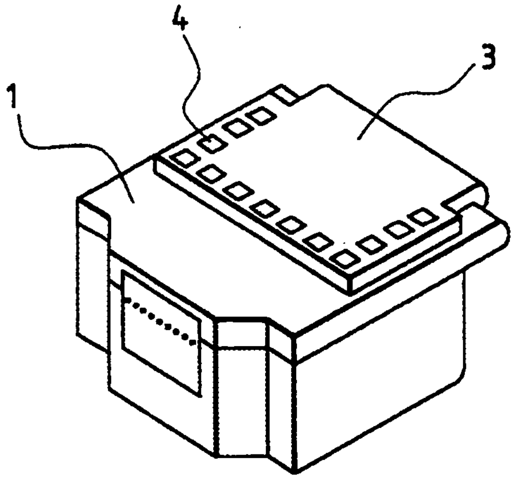

FIG. 2A

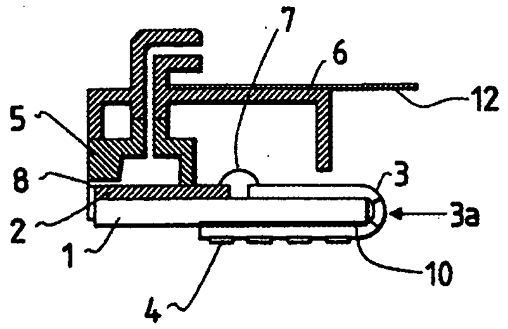

FIG. 2B

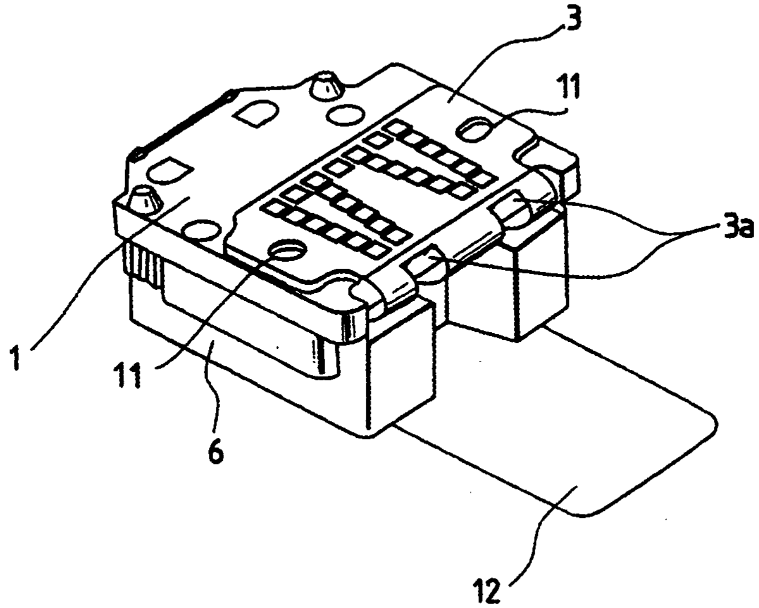

FIG. 3

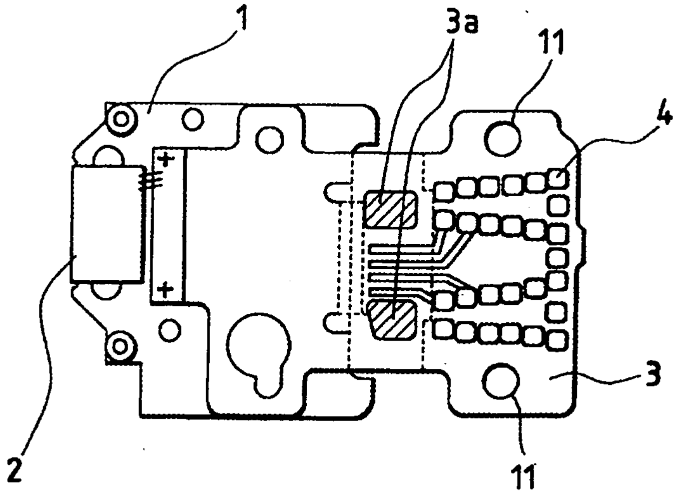

FIG. 4A

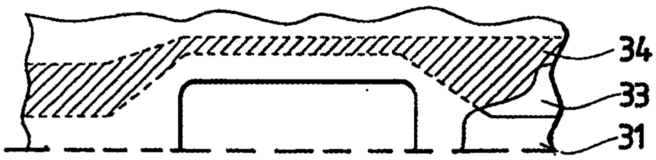

FIG. 4B

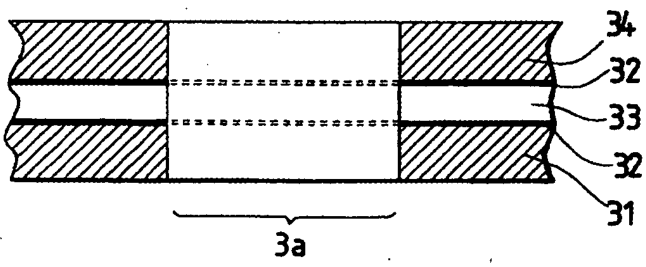

FIG. 5

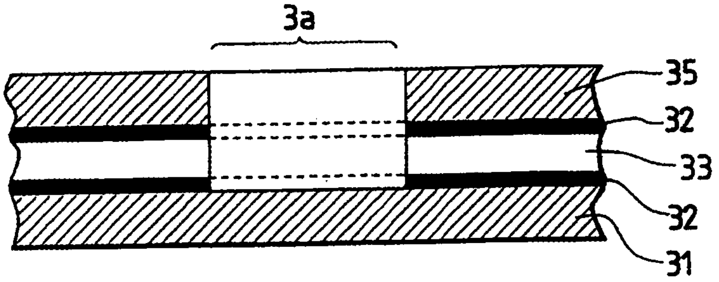

FIG. 6

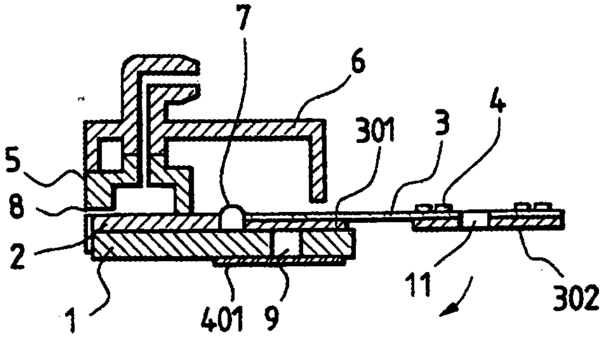

FIG. 7

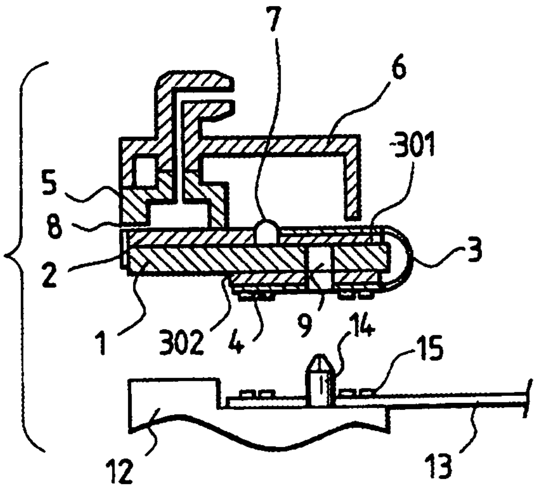

FIG. 8

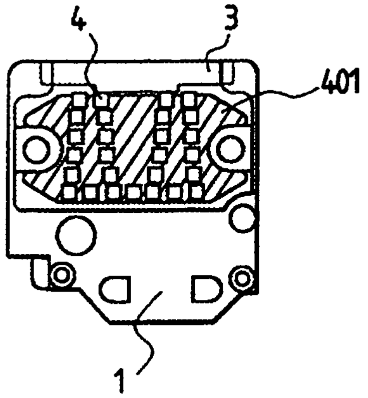

FIG. 9

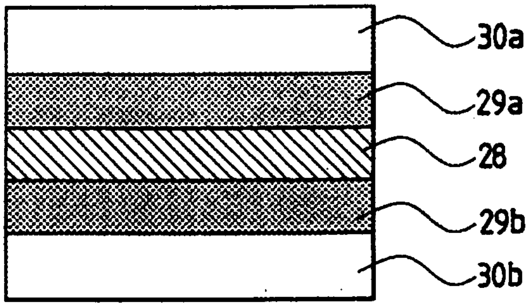

FIG. 10

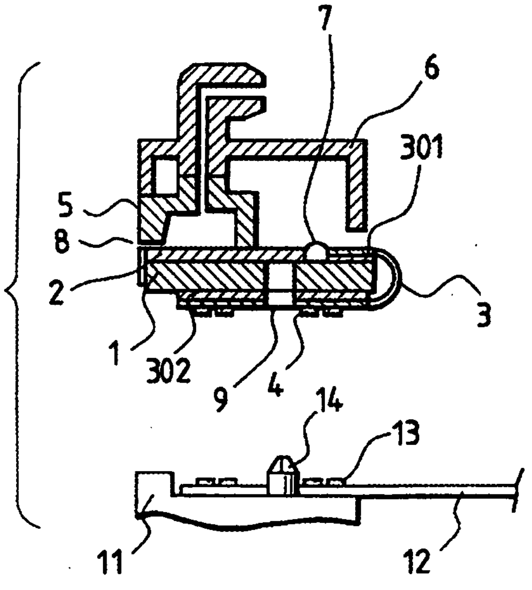

FIG. 11A

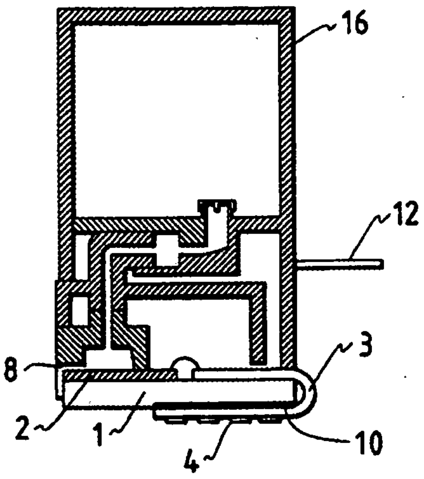

FIG. 11B

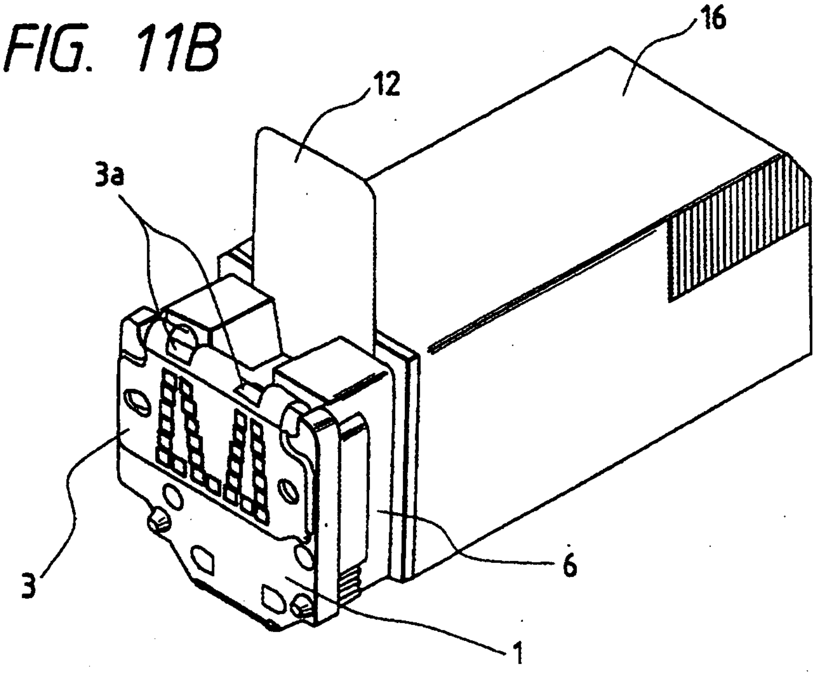

FIG. 12A

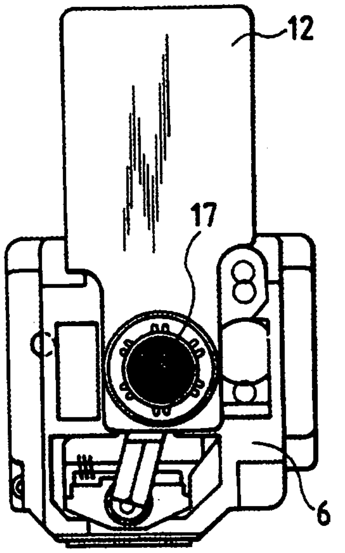

FIG. 12C

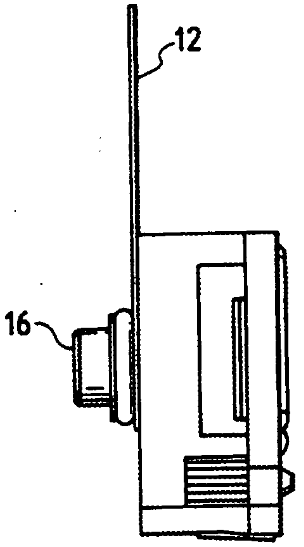

FIG. 12B

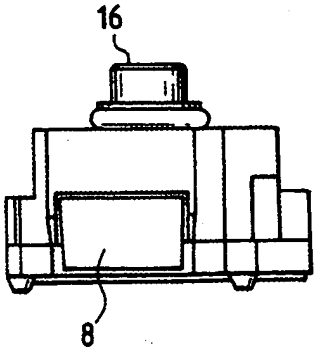

FIG. 13A

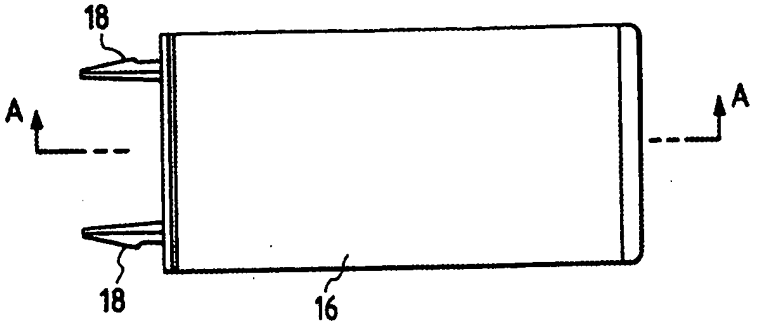

FIG. 13B

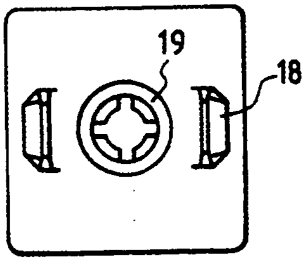

FIG. 13C

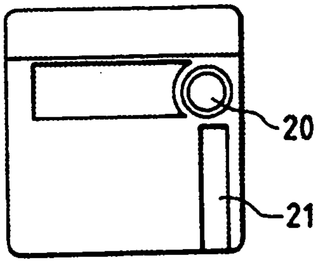

FIG. 13D

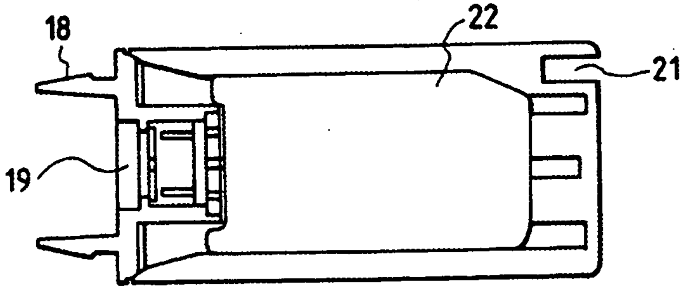

FIG. 14

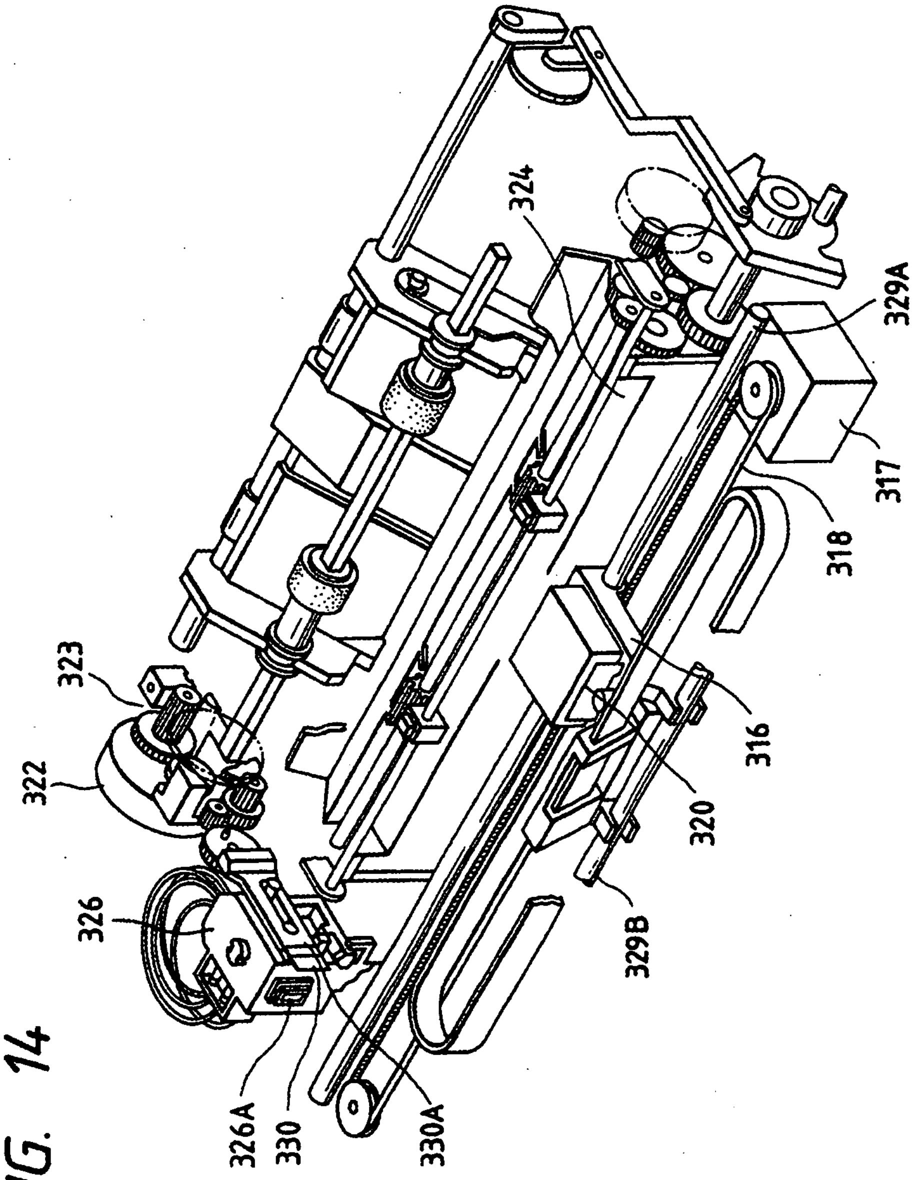

FIG. 15

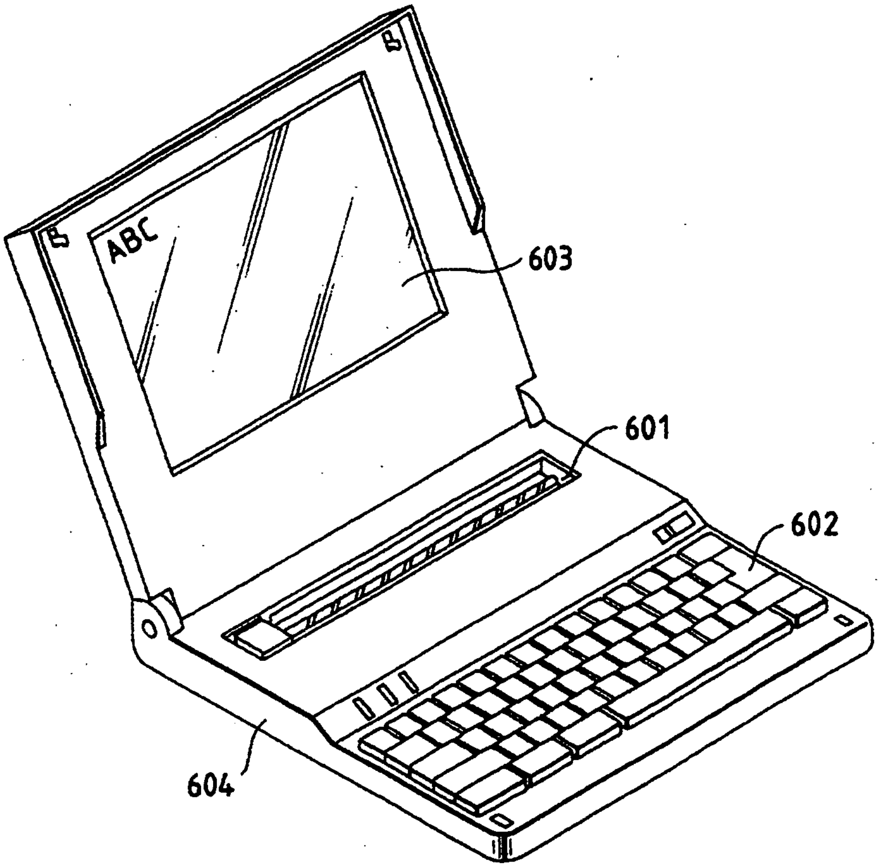

FIG. 16

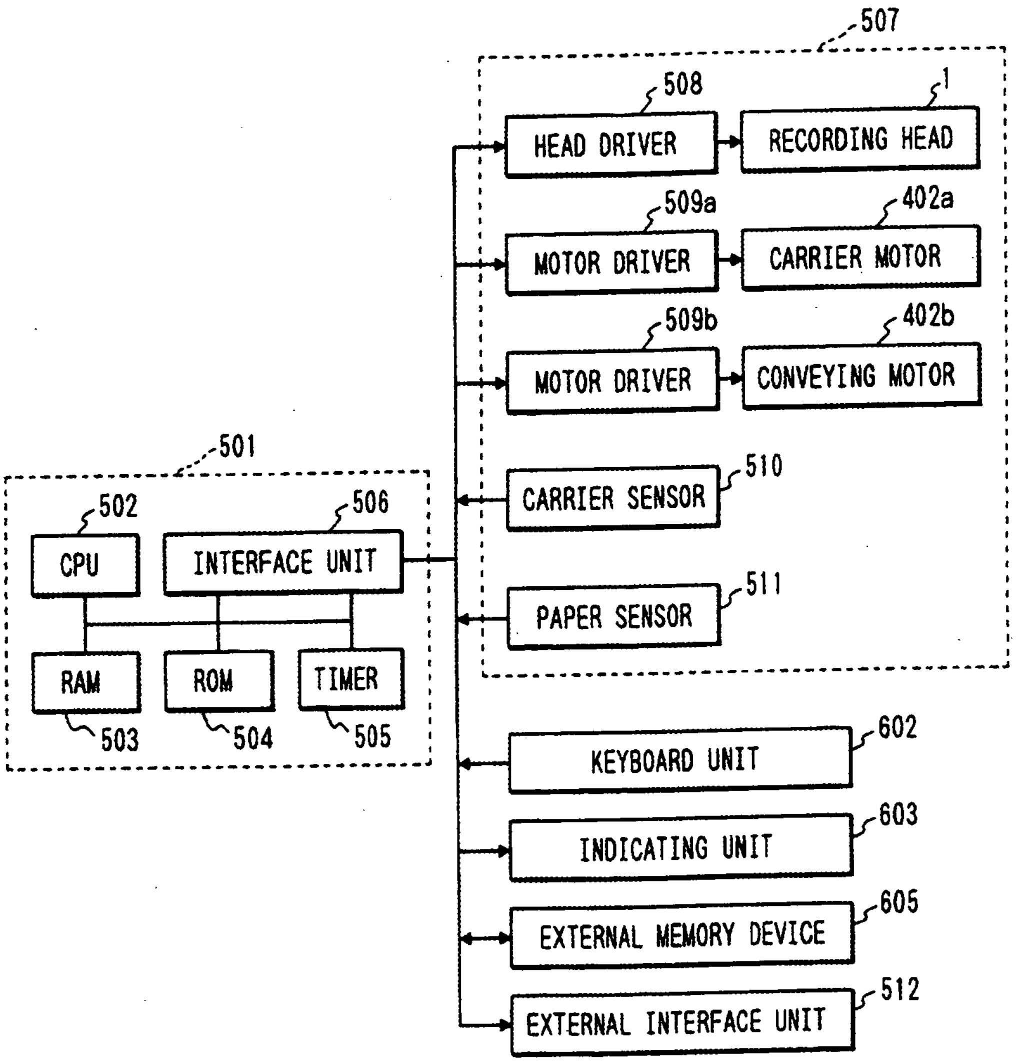
507
508
HEAD DRIVER
1
RECORDING HEAD
509a
MOTOR DRIVER
402a
CARRIER MOTOR
509b
MOTOR DRIVER
402b
CONVEYING MOTOR
501
510
CARRIER SENSOR
502
CPU
506
INTERFACE UNIT
511
PAPER SENSOR
RAM
ROM
TIMER
503
504
505
602
KEYBOARD UNIT
603
INDICATING UNIT
605
EXTERNAL MEMORY DEVICE
512
EXTERNAL INTERFACE UNIT

FIG. 17

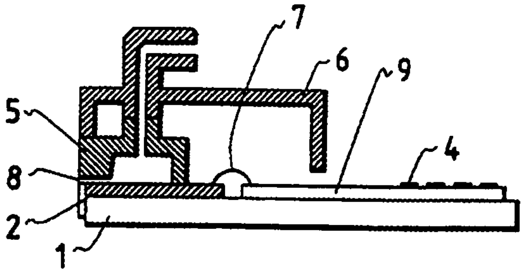

FIG. 18